

*The Extrusion Press Maintenance Manual*

# USEFUL TABLES

## CONVERSION OF UNITS

### Length

|              |                     |
|--------------|---------------------|
| 1 millimeter | = 0.0394 inch       |
| 1 centimeter | = 0.394 inch        |
| 1 meter      | = 39.4 inches       |
| 1 meter      | = 3.2808 feet       |
| 1 kilometer  | = 0.62137 mile      |
| 1 inch       | = 25.4 millimeters  |
| 1 inch       | = 2.54 centimeters  |
| 1 foot       | = 30.48 centimeters |
| 1 foot       | = 0.305 meter       |
| 1 yard       | = 0.9144 meter      |
| 1 mile       | = 1.60935 meters    |

### Area

|                     |                            |
|---------------------|----------------------------|
| 1 square millimeter | = 0.00155 square inch      |
| 1 square centimeter | = 0.1550 square inch       |
| 1 square meter      | = 10.764 square feet       |
| 1 square kilometer  | = 0.3861 square mile       |
| 1 square inch       | = 6.452 square centimeters |
| 1 square inch       | = 645.2 square millimeters |
| 1 square foot       | = 0.0929 square meter      |
| 1 square yard       | = 0.8361 square meter      |
| 1 square mile       | = 2.590 square kilometers  |

### Volume

|                    |                             |
|--------------------|-----------------------------|
| 1 cubic millimeter | = 0.0006 cubic inch         |
| 1 cubic centimeter | = 0.0610 cubic inch         |
| 1 liter            | = 0.26418 gallon            |
| 1 liter            | = 1000 cubic centimeters    |
| 1 cubic meter      | = 1.3079 cubic yards        |
| 1 cubic meter      | = 35.313 cubic feet         |
| 1 cubic meter      | = 264.143 gallons           |
| 1 cubic inch       | = 16.3872 cubic centimeters |
| 1 cubic inch       | = 1638.72 cubic millimeters |
| 1 gallon           | = 3.78533 liters            |
| 1 cubic foot       | = 28.32 liters              |
| 1 cubic foot       | = 0.02832 cubic meters      |
| 1 cubic foot       | = 1728 cubic inches         |
| 1 cubic foot       | = 7.48 gallons              |
| 1 cubic yard       | = 0.7656 cubic meter        |

**Weight**

|                  |                    |
|------------------|--------------------|
| 1 gram           | = 15.4324 grains   |
| 1 kilogram       | = 2.20462 pounds   |
| 1 Tonne (metric) | = 1000 kilograms   |
| 1 Tonne (metric) | = 2200 pounds      |
| 1 Tonne (metric) | = 1.1023 Tons      |
| 1 grain          | = 0.0648 ounce     |
| 1 ounce          | = 28.3495 grams    |
| 1 pound          | = 0.45359 kilogram |
| 1 pound          | = 16 ounces        |
| 1 Ton (US)       | = 2000 pounds      |
| 1 Ton (US)       | = 907.18 kilograms |

**Pressure**

|                             |                                   |
|-----------------------------|-----------------------------------|
| 1 kg/cm <sup>2</sup>        | = 14.22 psi (lb/in <sup>2</sup> ) |
| 1 bar                       | = 750.1 mm Mercury                |
| 1 bar                       | = 100.0 kPa (kilopascal)          |
| 1 bar                       | = 10,200 mm WC                    |
| 1 bar                       | = 14.50 psi (lb/in <sup>2</sup> ) |
| 1 psi (lb/in <sup>2</sup> ) | = 0.0703 kg/cm <sup>2</sup>       |
| 1 psi (lb/in <sup>2</sup> ) | = 0.06897 bar                     |

**Power, Work, and Heat**

|               |                                 |
|---------------|---------------------------------|
| 1 Calorie     | = 0.00397 Btu                   |
| 1 Kilocalorie | = 3.968 Btu                     |
| 1 KCalorie/Kg | = 1.8037 Btu/lb                 |
| 1 Watt        | = 0.056884 BTU/min.             |
| 1 watt        | = 1 X 10 <sup>7</sup> ergs/sec. |
| 1 Kilowatt    | = 738 ft-lbs/sec.               |
| 1 Kilowatt    | = 1.341 horsepower              |
| 1 BTU         | = 252.0 Calories                |
| 1 BTU         | = 0.2520 Kilocalories           |
| 1 BTU/pound   | = 0.5556 KCal/kilogram          |
| 1 horsepower  | = 745.7 watts                   |
| 1 horsepower  | = 33,000 ft-lbs/min.            |

**TEMPERATURE CONVERSION***Formulas for Conversion*

$$^{\circ}\text{F} = (^{\circ}\text{C} \times 1.8) + 32$$

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32)/1.8$$

To use the table below, locate the temperature to be converted in the center column. Then to convert °F to °C read the left column; to convert °C to °F read the right column.

| °C    |     | °F   |  | °C  |     | °F  |  | °C  |     | °F   |  | °C  |      | °F   |
|-------|-----|------|--|-----|-----|-----|--|-----|-----|------|--|-----|------|------|
| -23   | -10 | 24   |  |     |     |     |  |     |     |      |  |     |      |      |
| -17.7 | 0   | 32   |  | 127 | 260 | 500 |  | 321 | 610 | 1130 |  | 515 | 960  | 1760 |
| -17.2 | 1   | 33.8 |  | 132 | 270 | 518 |  | 326 | 620 | 1148 |  | 520 | 970  | 1778 |
| -16.6 | 2   | 35.6 |  | 138 | 280 | 536 |  | 332 | 630 | 1166 |  | 526 | 980  | 1796 |
| -16.1 | 3   | 37.4 |  | 143 | 290 | 554 |  | 338 | 640 | 1184 |  | 532 | 990  | 1814 |
| -15.5 | 4   | 39.2 |  | 149 | 300 | 572 |  | 343 | 650 | 1202 |  | 538 | 1000 | 1832 |

| °C    |     | °F   |  | °C  |     | °F   |  | °C  |     | °F   |  | °C  |      | °F   |
|-------|-----|------|--|-----|-----|------|--|-----|-----|------|--|-----|------|------|
| -15.0 | 5   | 41   |  | 154 | 310 | 590  |  | 349 | 660 | 1220 |  | 543 | 1010 | 1850 |
| -14.4 | 6   | 42.8 |  | 160 | 320 | 608  |  | 354 | 670 | 1238 |  | 549 | 1020 | 1868 |
| -13.9 | 7   | 44.6 |  | 165 | 330 | 626  |  | 360 | 680 | 1256 |  | 554 | 1030 | 1886 |
| -13.3 | 8   | 46.4 |  | 171 | 340 | 644  |  | 365 | 690 | 1274 |  | 560 | 1040 | 1904 |
| -12.7 | 9   | 48.2 |  | 177 | 350 | 662  |  | 371 | 700 | 1292 |  | 565 | 1050 | 1922 |
| -12.2 | 10  | 50   |  | 182 | 360 | 680  |  | 376 | 710 | 1310 |  | 571 | 1060 | 1940 |
| -6.6  | 20  | 68   |  | 188 | 370 | 698  |  | 382 | 720 | 1328 |  | 576 | 1070 | 1958 |
| -1.1  | 30  | 86   |  | 193 | 380 | 716  |  | 387 | 730 | 1346 |  | 582 | 1080 | 1976 |
| 4.4   | 40  | 104  |  | 199 | 390 | 734  |  | 393 | 740 | 1364 |  | 587 | 1090 | 1994 |
| 9.9   | 50  | 122  |  | 204 | 400 | 752  |  | 399 | 750 | 1382 |  | 593 | 1100 | 2012 |
| 15.6  | 60  | 140  |  | 210 | 410 | 770  |  | 404 | 760 | 1400 |  | 598 | 1110 | 2030 |
| 21.0  | 70  | 158  |  | 215 | 420 | 788  |  | 410 | 770 | 1418 |  | 604 | 1120 | 2048 |
| 26.8  | 80  | 176  |  | 221 | 430 | 806  |  | 415 | 780 | 1436 |  | 609 | 1130 | 2066 |
| 32.1  | 90  | 194  |  | 226 | 440 | 824  |  | 421 | 790 | 1454 |  | 615 | 1140 | 2084 |
| 37.7  | 100 | 212  |  | 232 | 450 | 842  |  | 426 | 800 | 1472 |  | 620 | 1150 | 2102 |
| 43    | 110 | 230  |  | 238 | 460 | 860  |  | 432 | 810 | 1490 |  | 626 | 1160 | 2120 |
| 49    | 120 | 248  |  | 243 | 470 | 878  |  | 438 | 820 | 1508 |  | 631 | 1170 | 2138 |
| 54    | 130 | 266  |  | 249 | 480 | 896  |  | 443 | 830 | 1526 |  | 637 | 1180 | 2156 |
| 60    | 140 | 284  |  | 254 | 490 | 914  |  | 449 | 840 | 1544 |  | 642 | 1190 | 2174 |
| 65    | 150 | 302  |  | 260 | 500 | 932  |  | 454 | 850 | 1562 |  | 648 | 1200 | 2192 |
| 71    | 160 | 320  |  | 265 | 510 | 950  |  | 460 | 860 | 1580 |  | 654 | 1210 | 2210 |
| 76    | 170 | 338  |  | 271 | 520 | 968  |  | 465 | 870 | 1598 |  | 660 | 1220 | 2228 |
| 83    | 180 | 356  |  | 276 | 530 | 986  |  | 471 | 880 | 1616 |  | 666 | 1230 | 2246 |
| 88    | 190 | 374  |  | 280 | 540 | 1004 |  | 476 | 890 | 1634 |  | 671 | 1240 | 2264 |
| 93    | 200 | 392  |  | 288 | 550 | 1022 |  | 482 | 900 | 1652 |  | 677 | 1250 | 2282 |
| 99    | 210 | 410  |  | 293 | 560 | 1040 |  | 487 | 910 | 1670 |  | 682 | 1260 | 2300 |
| 104   | 220 | 428  |  | 299 | 570 | 1058 |  | 493 | 920 | 1688 |  | 688 | 1270 | 2318 |
| 110   | 230 | 446  |  | 304 | 580 | 1076 |  | 498 | 930 | 1706 |  | 693 | 1280 | 2336 |
| 115   | 240 | 464  |  | 310 | 590 | 1084 |  | 504 | 940 | 1724 |  | 699 | 1290 | 2354 |
| 121   | 250 | 482  |  | 315 | 600 | 1112 |  | 510 | 950 | 1742 |  | 704 | 1300 | 2372 |

## STRETCHER CAPACITY CALCULATION – ENGLISH UNITS

For Aluminum Alloys - 6061 - 6063

| Alloy 6063 T4 (yield = 10000psi) |                                    |                   | Alloy 6061 T4 (yield = 16000psi) |                                    |                   | Alloy 6061 T6 (yield = 35000psi) |                                    |                   |
|----------------------------------|------------------------------------|-------------------|----------------------------------|------------------------------------|-------------------|----------------------------------|------------------------------------|-------------------|
| Stretcher<br>Capacity Tons       | Area of<br>Profile In <sup>2</sup> | Weight<br>Lb/foot | Stretcher<br>Capacity Tons       | Area of<br>Profile In <sup>2</sup> | Weight<br>Lb/foot | Stretcher<br>Capacity Tons       | Area of<br>Profile In <sup>2</sup> | Weight<br>Lb/foot |
| 2                                | 0.40                               | 0.48              | 2                                | 0.25                               | 0.30              | 2                                | 0.11                               | 0.14              |
| 4                                | 0.80                               | 0.96              | 4                                | 0.50                               | 0.60              | 4                                | 0.23                               | 0.27              |
| 6                                | 1.20                               | 1.44              | 6                                | 0.75                               | 0.90              | 6                                | 0.34                               | 0.41              |
| 8                                | 1.60                               | 1.92              | 8                                | 1.00                               | 1.20              | 8                                | 0.46                               | 0.55              |
| 10                               | 2.00                               | 2.40              | 10                               | 1.25                               | 1.50              | 10                               | 0.57                               | 0.69              |
| 15                               | 3.00                               | 3.60              | 15                               | 1.88                               | 2.25              | 15                               | 0.86                               | 1.03              |
| 20                               | 4.00                               | 4.80              | 20                               | 2.50                               | 3.00              | 20                               | 1.14                               | 1.37              |
| 25                               | 5.00                               | 6.00              | 25                               | 3.13                               | 3.75              | 25                               | 1.43                               | 1.71              |
| 30                               | 6.00                               | 7.20              | 30                               | 3.75                               | 4.50              | 30                               | 1.71                               | 2.06              |
| 35                               | 7.00                               | 8.40              | 35                               | 4.38                               | 5.25              | 35                               | 2.00                               | 2.40              |
| 40                               | 8.00                               | 9.60              | 40                               | 5.00                               | 6.00              | 40                               | 2.29                               | 2.74              |
| 45                               | 9.00                               | 10.80             | 45                               | 5.63                               | 6.75              | 45                               | 2.57                               | 3.09              |
| 50                               | 10.00                              | 12.00             | 50                               | 6.25                               | 7.50              | 50                               | 2.86                               | 3.43              |
| 55                               | 11.00                              | 13.20             | 55                               | 6.88                               | 8.25              | 55                               | 3.14                               | 3.77              |
| 60                               | 12.00                              | 14.40             | 60                               | 7.50                               | 9.00              | 60                               | 3.43                               | 4.11              |
| 65                               | 13.00                              | 15.60             | 65                               | 8.13                               | 9.75              | 65                               | 3.71                               | 4.46              |
| 70                               | 14.00                              | 16.80             | 70                               | 8.75                               | 10.50             | 70                               | 4.00                               | 4.80              |
| 75                               | 15.00                              | 18.00             | 75                               | 9.38                               | 11.25             | 75                               | 4.29                               | 5.14              |
| 80                               | 16.00                              | 19.20             | 80                               | 10.00                              | 12.00             | 80                               | 4.57                               | 5.49              |
| 85                               | 17.00                              | 20.40             | 85                               | 10.63                              | 12.75             | 85                               | 4.86                               | 5.83              |
| 90                               | 18.00                              | 21.60             | 90                               | 11.25                              | 13.50             | 90                               | 5.14                               | 6.17              |
| 95                               | 19.00                              | 22.80             | 95                               | 11.88                              | 14.25             | 95                               | 5.43                               | 6.51              |
| 100                              | 20.00                              | 24.00             | 100                              | 12.50                              | 15.00             | 100                              | 5.71                               | 6.86              |
| 110                              | 22.00                              | 26.40             | 110                              | 13.75                              | 16.50             | 110                              | 6.29                               | 7.54              |
| 125                              | 25.00                              | 30.00             | 125                              | 15.63                              | 18.75             | 125                              | 7.14                               | 8.57              |
| 150                              | 30.00                              | 36.00             | 150                              | 18.75                              | 22.50             | 150                              | 8.57                               | 10.29             |
| 175                              | 35.00                              | 42.00             | 175                              | 21.88                              | 26.25             | 175                              | 10.00                              | 12.00             |
| 200                              | 40.00                              | 48.00             | 200                              | 25.00                              | 30.00             | 200                              | 11.43                              | 13.71             |
| 225                              | 45.00                              | 54.00             | 225                              | 28.13                              | 33.75             | 225                              | 12.86                              | 15.43             |
| 250                              | 50.00                              | 60.00             | 250                              | 31.25                              | 37.50             | 250                              | 14.29                              | 17.14             |
| 275                              | 55.00                              | 66.00             | 275                              | 34.38                              | 41.25             | 275                              | 15.71                              | 18.86             |
| 300                              | 60.00                              | 72.00             | 300                              | 37.50                              | 45.00             | 300                              | 17.14                              | 20.57             |
| 350                              | 70.00                              | 84.00             | 350                              | 43.75                              | 52.50             | 350                              | 20.00                              | 24.00             |

| Alloy 6063 T4 (yield = 10000psi) |                                 |                | Alloy 6061 T4 (yield = 16000psi) |                                 |                | Alloy 6061 T6 (yield = 35000psi) |                                 |                |
|----------------------------------|---------------------------------|----------------|----------------------------------|---------------------------------|----------------|----------------------------------|---------------------------------|----------------|
| Stretcher Capacity Tons          | Area of Profile In <sup>2</sup> | Weight Lb/foot | Stretcher Capacity Tons          | Area of Profile In <sup>2</sup> | Weight Lb/foot | Stretcher Capacity Tons          | Area of Profile In <sup>2</sup> | Weight Lb/foot |
| 400                              | 80.00                           | 96.00          | 400                              | 50.00                           | 60.00          | 400                              | 22.86                           | 27.43          |
| 450                              | 90.00                           | 108.00         | 450                              | 56.25                           | 67.50          | 450                              | 25.71                           | 30.86          |
| 500                              | 100.00                          | 120.00         | 500                              | 62.50                           | 75.00          | 500                              | 28.57                           | 34.29          |
| 550                              | 110.00                          | 132.00         | 550                              | 68.75                           | 82.50          | 550                              | 31.43                           | 37.71          |
| 600                              | 120.00                          | 144.00         | 600                              | 75.00                           | 90.00          | 600                              | 34.29                           | 41.14          |
| 650                              | 130.00                          | 156.00         | 650                              | 81.25                           | 97.50          | 650                              | 37.14                           | 44.57          |
| 700                              | 140.00                          | 168.00         | 700                              | 87.50                           | 105.00         | 700                              | 40.00                           | 48.00          |
| 750                              | 150.00                          | 180.00         | 750                              | 93.75                           | 112.50         | 750                              | 42.86                           | 51.43          |
| 800                              | 160.00                          | 192.00         | 800                              | 100.00                          | 120.00         | 800                              | 45.71                           | 54.86          |
| 900                              | 180.00                          | 216.00         | 900                              | 112.50                          | 135.00         | 900                              | 51.43                           | 61.71          |
| 1000                             | 200.00                          | 240.00         | 1000                             | 125.00                          | 150.00         | 1000                             | 57.14                           | 68.57          |

## STRETCHER CAPACITY CALCULATION – METRIC UNITS

For Aluminum Alloys - 6061 - 6063

| Alloy 6063 T4 (yield =68.95MPa) |                                 |             | Alloy 6061 T4 (yield =110.32MPa) |                                 |             | Alloy 6061 T6 (yield =241.33MPa) |                                 |             |
|---------------------------------|---------------------------------|-------------|----------------------------------|---------------------------------|-------------|----------------------------------|---------------------------------|-------------|
| Stretcher Capacity M Tons       | Area of Profile mm <sup>2</sup> | Weight kg/M | Stretcher Capacity M Tons        | Area of Profile mm <sup>2</sup> | Weight kg/M | Stretcher Capacity M Tons        | Area of Profile mm <sup>2</sup> | Weight kg/M |
| 2                               | 290                             | 0.80        | 2                                | 181                             | 0.50        | 2                                | 83                              | 0.23        |
| 4                               | 580                             | 1.60        | 4                                | 363                             | 1.00        | 4                                | 166                             | 0.46        |
| 6                               | 870                             | 2.39        | 6                                | 544                             | 1.50        | 6                                | 249                             | 0.68        |
| 8                               | 1160                            | 3.19        | 8                                | 725                             | 1.99        | 8                                | 332                             | 0.91        |
| 10                              | 1450                            | 3.99        | 10                               | 906                             | 2.49        | 10                               | 414                             | 1.14        |
| 15                              | 2175                            | 5.98        | 15                               | 1360                            | 3.74        | 15                               | 622                             | 1.71        |
| 20                              | 2901                            | 7.98        | 20                               | 1813                            | 4.99        | 20                               | 829                             | 2.28        |
| 25                              | 3626                            | 9.97        | 25                               | 2266                            | 6.23        | 25                               | 1036                            | 2.85        |
| 30                              | 4351                            | 11.97       | 30                               | 2719                            | 7.48        | 30                               | 1243                            | 3.42        |
| 35                              | 5076                            | 13.96       | 35                               | 3173                            | 8.72        | 35                               | 1450                            | 3.99        |
| 40                              | 5801                            | 15.95       | 40                               | 3626                            | 9.97        | 40                               | 1658                            | 4.56        |
| 45                              | 6526                            | 17.95       | 45                               | 4079                            | 11.22       | 45                               | 1865                            | 5.13        |
| 50                              | 7252                            | 19.94       | 50                               | 4532                            | 12.46       | 50                               | 2072                            | 5.70        |
| 60                              | 8702                            | 23.93       | 60                               | 5439                            | 14.96       | 60                               | 2486                            | 6.84        |

| Alloy 6063 T4 (yield =68.95MPa) |                                 |             | Alloy 6061 T4 (yield =110.32MPa) |                                 |             | Alloy 6061 T6 (yield =241.33MPa) |                                 |             |
|---------------------------------|---------------------------------|-------------|----------------------------------|---------------------------------|-------------|----------------------------------|---------------------------------|-------------|
| Stretcher Capacity M Tons       | Area of Profile mm <sup>2</sup> | Weight kg/M | Stretcher Capacity M Tons        | Area of Profile mm <sup>2</sup> | Weight kg/M | Stretcher Capacity M Tons        | Area of Profile mm <sup>2</sup> | Weight kg/M |
| 70                              | 10152                           | 27.92       | 70                               | 6345                            | 17.45       | 70                               | 2901                            | 7.98        |
| 75                              | 10877                           | 29.91       | 75                               | 6798                            | 18.70       | 75                               | 3108                            | 8.55        |
| 80                              | 11603                           | 31.91       | 80                               | 7252                            | 19.94       | 80                               | 3315                            | 9.12        |
| 85                              | 12328                           | 33.90       | 85                               | 7705                            | 21.19       | 85                               | 3522                            | 9.69        |
| 90                              | 13053                           | 35.90       | 90                               | 8158                            | 22.43       | 90                               | 3729                            | 10.26       |
| 95                              | 13778                           | 37.89       | 95                               | 8611                            | 23.68       | 95                               | 3937                            | 10.83       |
| 100                             | 14503                           | 39.88       | 100                              | 9065                            | 24.93       | 100                              | 4144                            | 11.40       |
| 110                             | 15954                           | 43.87       | 110                              | 9971                            | 27.42       | 110                              | 4558                            | 12.53       |
| 120                             | 17404                           | 47.86       | 120                              | 10877                           | 29.91       | 120                              | 4973                            | 13.67       |
| 125                             | 18129                           | 49.85       | 125                              | 11331                           | 31.16       | 125                              | 5180                            | 14.24       |
| 150                             | 21755                           | 59.83       | 150                              | 13597                           | 37.39       | 150                              | 6216                            | 17.09       |
| 175                             | 25381                           | 69.80       | 175                              | 15863                           | 43.62       | 175                              | 7252                            | 19.94       |
| 200                             | 29007                           | 79.77       | 200                              | 18129                           | 49.85       | 200                              | 8288                            | 22.79       |
| 225                             | 32632                           | 89.74       | 225                              | 20395                           | 56.09       | 225                              | 9324                            | 25.64       |
| 250                             | 36258                           | 99.71       | 250                              | 22661                           | 62.32       | 250                              | 10359                           | 28.49       |
| 275                             | 39884                           | 109.68      | 275                              | 24927                           | 68.55       | 275                              | 11395                           | 31.34       |
| 300                             | 43510                           | 119.65      | 300                              | 27194                           | 74.78       | 300                              | 12431                           | 34.19       |
| 325                             | 47136                           | 129.62      | 325                              | 29460                           | 81.01       | 325                              | 13467                           | 37.04       |
| 350                             | 50761                           | 139.59      | 350                              | 31726                           | 87.25       | 350                              | 14503                           | 39.88       |
| 400                             | 58013                           | 159.54      | 400                              | 36258                           | 99.71       | 400                              | 16575                           | 45.58       |
| 450                             | 65265                           | 179.48      | 450                              | 40790                           | 112.17      | 450                              | 18647                           | 51.28       |
| 500                             | 72516                           | 199.42      | 500                              | 45323                           | 124.64      | 500                              | 20719                           | 56.98       |
| 550                             | 79768                           | 219.36      | 550                              | 49855                           | 137.10      | 550                              | 22791                           | 62.67       |
| 600                             | 87020                           | 239.30      | 600                              | 54387                           | 149.56      | 600                              | 24863                           | 68.37       |
| 650                             | 94271                           | 259.25      | 650                              | 58920                           | 162.03      | 650                              | 26935                           | 74.07       |
| 700                             | 101523                          | 279.19      | 700                              | 63452                           | 174.49      | 700                              | 29007                           | 79.77       |
| 750                             | 108774                          | 299.13      | 750                              | 67984                           | 186.96      | 750                              | 31078                           | 85.47       |
| 800                             | 116026                          | 319.07      | 800                              | 72516                           | 199.42      | 800                              | 33150                           | 91.16       |
| 900                             | 130529                          | 358.96      | 900                              | 81581                           | 224.35      | 900                              | 37294                           | 102.56      |
| 1000                            | 145033                          | 398.84      | 1000                             | 90645                           | 249.27      | 1000                             | 41438                           | 113.95      |

## WEIGHT OF EXTRUSION BILLETS

For Aluminum Alloys 1100 - 6061 - 6063 only

| Billet Length |       | Weight (in Pounds) for Diameter (in inches) |       |        |        |        |        |        |        |        |
|---------------|-------|---------------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|
| (inches)      | 5"    |                                             | 6"    | 7"     | 8"     | 9"     | 10"    | 11"    | 12"    | 14"    |
| 1"            | 1.893 | 1.893                                       | 2.714 | 3.700  | 4.878  | 6.129  | 7.621  | 9.221  | 10.83  | 14.937 |
| 8"            | 15.14 | 15.14                                       | 21.71 | 29.60  | 39.02  |        |        |        |        |        |
| 9"            | 17.04 | 17.04                                       | 24.43 | 33.30  | 43.90  | 55.16  |        |        |        |        |
| 10"           | 18.93 | 18.93                                       | 27.14 | 37.00  | 48.78  | 61.29  | 76.21  |        |        |        |
| 11"           | 20.82 | 20.82                                       | 29.85 | 40.70  | 53.66  | 67.42  | 83.83  | 101.43 |        |        |
| 12"           | 22.72 | 22.72                                       | 32.57 | 44.40  | 58.54  | 73.55  | 91.45  | 110.65 | 129.96 |        |
| 13"           | 24.61 | 24.61                                       | 35.28 | 48.10  | 63.41  | 79.68  | 99.07  | 119.87 | 140.79 |        |
| 14"           | 26.50 | 26.50                                       | 38.00 | 51.80  | 68.29  | 85.81  | 106.69 | 129.09 | 151.62 | 209.12 |
| 15"           | 28.40 | 28.40                                       | 40.71 | 55.50  | 73.17  | 91.94  | 114.32 | 138.32 | 162.45 | 224.06 |
| 16"           | 30.29 | 30.29                                       | 43.42 | 59.20  | 78.05  | 98.06  | 121.94 | 147.54 | 173.28 | 238.99 |
| 17"           | 32.18 | 32.18                                       | 46.14 | 62.90  | 82.93  | 104.19 | 129.56 | 156.76 | 184.11 | 253.93 |
| 18"           | 34.07 | 34.07                                       | 48.85 | 66.60  | 87.80  | 110.32 | 137.18 | 165.98 | 194.94 | 268.87 |
| 19"           | 35.97 | 35.97                                       | 51.57 | 70.30  | 92.68  | 116.45 | 144.80 | 175.20 | 205.77 | 283.80 |
| 20"           | 37.86 | 37.86                                       | 54.28 | 74.00  | 97.56  | 122.58 | 152.42 | 184.42 | 216.60 | 298.74 |
| 21"           | 39.75 | 39.75                                       | 56.99 | 77.70  | 102.44 | 128.71 | 160.04 | 193.64 | 227.43 | 313.68 |
| 22"           | 41.65 | 41.65                                       | 59.71 | 81.40  | 107.32 | 134.84 | 167.66 | 202.86 | 238.26 | 328.61 |
| 23"           | 43.54 | 43.54                                       | 62.42 | 85.10  | 112.19 | 140.97 | 175.28 | 212.08 | 249.09 | 343.55 |
| 24"           | 45.43 | 45.43                                       | 65.14 | 88.80  | 117.07 | 147.10 | 182.90 | 221.30 | 259.92 | 358.49 |
| 25"           | 47.33 | 47.33                                       | 67.85 | 92.50  | 121.95 | 153.23 | 190.53 | 230.53 | 270.75 | 373.43 |
| 26"           | 49.22 | 49.22                                       | 70.56 | 96.20  | 126.83 | 159.35 | 198.15 | 239.75 | 281.58 | 388.36 |
| 27"           | 51.11 | 51.11                                       | 73.28 | 99.90  | 131.71 | 165.48 | 205.77 | 248.97 | 292.41 | 403.30 |
| 28"           | 53.00 | 53.00                                       | 75.99 | 103.60 | 136.58 | 171.61 | 213.39 | 258.19 | 303.24 | 418.24 |
| 29"           | 54.90 | 54.90                                       | 78.71 | 107.30 | 141.46 | 177.74 | 221.01 | 267.41 | 314.07 | 433.17 |
| 30"           | 56.79 | 56.79                                       | 81.42 | 111.00 | 146.34 | 183.87 | 228.63 | 276.63 | 324.90 | 448.11 |
| 31"           | 58.68 | 58.68                                       | 84.13 | 114.70 | 151.22 | 190.00 | 236.25 | 285.85 | 335.73 | 463.05 |
| 32"           | 60.58 | 60.58                                       | 86.85 | 118.40 | 156.10 | 196.13 | 243.87 | 295.07 | 346.56 | 477.98 |
| 33"           | 62.47 | 62.47                                       | 89.56 | 122.10 | 160.97 | 202.26 | 251.49 | 304.29 | 357.39 | 492.92 |
| 34"           | 64.36 | 64.36                                       | 92.28 | 125.80 | 165.85 | 208.39 | 259.11 | 313.51 | 368.22 | 507.86 |
| 35"           | 66.26 | 66.26                                       | 94.99 | 129.50 | 170.73 | 214.52 | 266.74 | 322.74 | 379.05 | 522.80 |
| 36"           |       |                                             | 97.70 | 133.20 | 175.61 | 220.64 | 274.36 | 331.96 | 389.88 | 537.73 |

| Billet Length |    |  | Weight (in Pounds) for Diameter (in inches) |        |        |        |        |        |        |        |
|---------------|----|--|---------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| (inches)      | 5" |  | 6"                                          | 7"     | 8"     | 9"     | 10"    | 11"    | 12"    | 14"    |
| 37"           |    |  | 100.42                                      | 136.90 | 180.49 | 226.77 | 281.98 | 341.18 | 400.71 | 552.67 |
| 38"           |    |  | 103.13                                      | 140.60 | 185.36 | 232.90 | 289.60 | 350.40 | 411.54 | 567.61 |
| 39"           |    |  | 105.85                                      | 144.30 | 190.24 | 239.03 | 297.22 | 359.62 | 422.37 | 582.54 |
| 40            |    |  | 108.56                                      | 148.00 | 195.12 | 245.16 | 304.84 | 368.84 | 433.20 | 597.48 |
| 41            |    |  |                                             | 151.70 | 200.00 | 251.29 | 312.46 | 378.06 | 444.03 | 612.42 |
| 42            |    |  |                                             | 155.40 | 204.88 | 257.42 | 320.08 | 387.28 | 454.86 | 627.35 |
| 43            |    |  |                                             | 159.10 | 209.75 | 263.55 | 327.70 | 396.50 | 465.69 | 642.29 |
| 44            |    |  |                                             | 162.80 | 214.63 | 269.68 | 335.32 | 405.72 | 476.52 | 657.23 |
| 45            |    |  |                                             |        | 219.51 | 275.81 | 342.95 | 414.95 | 487.35 | 672.17 |
| 46            |    |  |                                             |        | 224.39 | 281.93 | 350.57 | 424.17 | 498.18 | 687.10 |
| 47            |    |  |                                             |        | 229.27 | 288.06 | 358.19 | 433.39 | 509.01 | 702.04 |
| 48            |    |  |                                             |        | 234.14 | 294.19 | 365.81 | 442.61 | 519.84 | 716.98 |

## PRESS SPECIFIC PRESSURE – ENGLISH UNITS

To calculate Specific Pressure on the die face:

$$P_s = \text{Press tonnage} \div \text{container area}$$

$$P_s = \text{Press tonnage} \times 2000 / (\text{container ID})^2 / 4$$

where  $P_s$  is in pounds/square inch and container ID is in inches (typically 3% larger than billet diameter).

| Billet Dia.-in.       | 6"                                                       | 7"     | 8"     | 9"     | 10"   | 12"    | 14"    |
|-----------------------|----------------------------------------------------------|--------|--------|--------|-------|--------|--------|
| Container I.D. – in.  | 6.18                                                     | 7.21   | 8.24   | 9.27   | 10.3  | 12.36  | 14.42  |
| Container Area - sqin | 30.00                                                    | 40.83  | 53.33  | 67.49  | 83.32 | 119.99 | 163.31 |
| Press Tons            | Press Specific pressure on Die Face – pounds/square inch |        |        |        |       |        |        |
| 900                   | 60,008                                                   |        |        |        |       |        |        |
| 1200                  | 80,010                                                   | 58,783 |        |        |       |        |        |
| 1400                  | 93,345                                                   | 68,580 |        |        |       |        |        |
| 1600                  | 106,680                                                  | 78,377 | 60,008 |        |       |        |        |
| 1800                  | 120,015                                                  | 88,174 | 67,508 |        |       |        |        |
| 2000                  | 133,350                                                  | 97,971 | 75,009 | 59,267 |       |        |        |

| Billet Dia.-in. | 6" | 7"      | 8"      | 9"      | 10"     | 12"     | 14"    |
|-----------------|----|---------|---------|---------|---------|---------|--------|
| 2200            |    | 107,769 | 82,510  | 65,193  |         |         |        |
| 2400            |    | 117,566 | 90,011  | 71,120  | 57,607  |         |        |
| 2500            |    | 122,464 | 93,762  | 74,083  | 60,008  |         |        |
| 2750            |    |         | 103,138 | 81,492  | 66,008  |         |        |
| 3000            |    |         | 112,514 | 88,900  | 72,009  |         |        |
| 3250            |    |         | 121,890 | 96,308  | 78,010  | 54,173  |        |
| 3500            |    |         |         | 103,717 | 84,011  | 58,341  |        |
| 3750            |    |         |         | 111,125 | 90,011  | 62,508  |        |
| 4000            |    |         |         |         | 96,012  | 66,675  |        |
| 4250            |    |         |         |         | 102,013 | 70,842  | 52,047 |
| 4500            |    |         |         |         | 108,014 | 75,009  | 55,109 |
| 5000            |    |         |         |         |         | 83,344  | 61,232 |
| 5500            |    |         |         |         |         | 91,678  | 67,355 |
| 6000            |    |         |         |         |         | 100,013 | 73,479 |
| 6500            |    |         |         |         |         |         | 79,602 |
| 7000            |    |         |         |         |         |         | 85,725 |

## Notes

- Many experts recommend operating with Specific Pressure (die face pressure) in the range of 85,000 to 115, 000 pounds/square inch.
- Many North American extruders operate in the range 70,000 to 80,000 psi.
- For extruding with longer billets (length greater than 4x billet diameter), Specific Pressures must be higher in the range of 120,000 psi, due to increased container friction.
- The optimum range of Specific Pressure will also depend on extrusion practices and the type of profile or bar being extruded.

## PRESS SPECIFIC PRESSURE – METRIC UNITS

To calculate Specific Pressure on the die face:

$P_s = \text{Press tonnage} \div \text{container area}$

$P_s = \text{Press tonnage} \times 1000 / (\text{container ID})^2 / 4$

where  $P_s$  is in kilograms/square millimeter and container ID is in millimeters (typically 3% larger than billet diameter).

| Billet Dia. – in.                | 6"                                                                | 7"    | 8"    | 9"    | 10"   | 12"   | 14"    |
|----------------------------------|-------------------------------------------------------------------|-------|-------|-------|-------|-------|--------|
| Billet Dia.-mm                   | 152                                                               | 178   | 203   | 228   | 254   | 305   | 356    |
| Container ID-mm                  | 160                                                               | 185   | 210   | 236   | 262   | 314   | 365    |
| Container Area – mm <sup>2</sup> | 20106                                                             | 26880 | 34636 | 43744 | 53913 | 77437 | 104635 |
| Press MTons                      | Press Specific pressure on Die Face – kilograms/square millimeter |       |       |       |       |       |        |
| 800                              | 39.79                                                             |       |       |       |       |       |        |
| 1000                             | 49.74                                                             | 37.20 |       |       |       |       |        |
| 1200                             | 59.68                                                             | 44.64 |       |       |       |       |        |
| 1400                             | 69.63                                                             | 52.08 | 40.42 |       |       |       |        |
| 1600                             | 79.58                                                             | 59.52 | 46.19 | 36.58 |       |       |        |
| 1800                             | 89.52                                                             | 66.96 | 51.97 | 41.15 |       |       |        |
| 2000                             | 99.47                                                             | 74.40 | 57.74 | 45.72 | 37.10 |       |        |
| 2200                             |                                                                   | 81.84 | 63.52 | 50.29 | 40.81 |       |        |
| 2400                             |                                                                   | 89.28 | 69.29 | 54.87 | 44.52 |       |        |
| 2600                             |                                                                   | 96.73 | 75.07 | 59.44 | 48.23 |       |        |
| 2800                             |                                                                   |       | 80.84 | 64.01 | 51.94 |       |        |
| 3000                             |                                                                   |       | 86.61 | 68.58 | 55.65 | 38.74 |        |
| 3200                             |                                                                   |       | 92.39 | 73.15 | 59.36 | 41.32 |        |
| 3400                             |                                                                   |       | 98.16 | 77.73 | 63.06 | 43.91 |        |
| 3600                             |                                                                   |       |       | 82.30 | 66.77 | 46.49 |        |
| 3800                             |                                                                   |       |       | 86.87 | 70.48 | 49.07 |        |
| 4000                             |                                                                   |       |       | 91.44 | 74.19 | 51.65 | 38.23  |
| 4500                             |                                                                   |       |       |       | 83.47 | 58.11 | 43.01  |
| 5000                             |                                                                   |       |       |       | 92.74 | 64.57 | 47.79  |
| 5500                             |                                                                   |       |       |       |       | 71.03 | 52.56  |
| 6000                             |                                                                   |       |       |       |       | 77.48 | 57.34  |
| 7000                             |                                                                   |       |       |       |       | 90.40 | 66.9   |

## Notes

- Many experts recommend operating with Specific Pressure (die face pressure) in the range of 60 to 80 kilograms/square millimeter.
- Many North American extruders operate in the range 50 to 60 kg/mm<sup>2</sup>.
- For extruding with longer billets (length greater than 4x billet diameter), Specific Pressures must be somewhat higher in the range of 825MPa, due to increased container friction.
- The optimum range of Specific Pressure will also depend on extrusion practices and the type of profile or bar being extruded.

## MILLIMETER CONVERSION

| mm  | Inches |  | mm | Inches |  | mm    | inches |
|-----|--------|--|----|--------|--|-------|--------|
| 0.1 | .0039  |  | 41 | 1.6142 |  | 90    | 3.5433 |
| 0.2 | .0079  |  | 42 | 1.6535 |  | 91    | 3.5827 |
| 0.3 | .0118  |  | 43 | 1.6929 |  | 92    | 3.6220 |
| 0.4 | .0157  |  | 44 | 1.7323 |  | 93    | 3.6614 |
| 0.5 | .0197  |  | 45 | 1.7717 |  | 94    | 3.7008 |
| 0.6 | .0236  |  | 46 | 1.8110 |  | 95    | 3.7402 |
| 0.7 | .0276  |  | 47 | 1.8504 |  | 96    | 3.7795 |
| 0.8 | .0315  |  | 48 | 1.8898 |  | 97    | 3.8189 |
| 0.9 | .0354  |  | 49 | 1.9291 |  | 98    | 3.8583 |
| 1   | .0393  |  | 50 | 1.9685 |  | 99    | 3.8976 |
| 2   | .0787  |  | 51 | 2.0079 |  | 100   | 3.9370 |
| 3   | 0.1181 |  | 52 | 2.0472 |  |       |        |
| 4   | 0.1575 |  | 53 | 2.0866 |  | 25.4  | 1      |
| 5   | 0.1969 |  | 54 | 2.1260 |  | 50.8  | 2      |
| 6   | 0.2362 |  | 55 | 2.1654 |  | 76.2  | 3      |
| 7   | 0.2756 |  | 56 | 2.2047 |  | 101.6 | 4      |
| 8   | 0.3150 |  | 57 | 2.2441 |  | 127.0 | 5      |
| 9   | 0.3543 |  | 58 | 2.2835 |  | 152.4 | 6      |
| 10  | 0.3937 |  | 59 | 2.3228 |  | 177.8 | 7      |
| 11  | 0.4331 |  | 60 | 2.3622 |  | 203.2 | 8      |
| 12  | 0.4724 |  | 61 | 2.4016 |  | 228.6 | 9      |
| 13  | 0.5118 |  | 62 | 2.4409 |  | 254.0 | 10     |

| mm | Inches |  | mm | Inches |  | mm     | inches |
|----|--------|--|----|--------|--|--------|--------|
| 14 | 0.5512 |  | 63 | 2.4803 |  | 279.4  | 11     |
| 15 | 0.5906 |  | 64 | 2.5197 |  | 304.8  | 12     |
| 16 | 0.6299 |  | 65 | 2.5591 |  | 330.2  | 13     |
| 17 | 0.6693 |  | 66 | 2.5984 |  | 355.6  | 14     |
| 18 | 0.7087 |  | 67 | 2.6378 |  | 381.0  | 15     |
| 19 | 0.7480 |  | 68 | 2.6772 |  | 406.4  | 16     |
| 20 | 0.7874 |  | 69 | 2.7165 |  | 431.8  | 17     |
| 21 | 0.8268 |  | 70 | 2.7559 |  | 457.2  | 18     |
| 22 | 0.8661 |  | 71 | 2.7953 |  | 482.6  | 19     |
| 23 | 0.9055 |  | 72 | 2.8346 |  | 508.0  | 20     |
| 24 | 0.9449 |  | 73 | 2.8740 |  | 609.6  | 24     |
| 25 | 0.9843 |  | 74 | 2.9134 |  | 762.0  | 30     |
| 26 | 1.0236 |  | 75 | 2.9528 |  | 914.4  | 36     |
| 27 | 1.0630 |  | 76 | 2.9921 |  | 1066.8 | 42     |
| 28 | 1.1024 |  | 77 | 3.0315 |  | 1219.2 | 48     |
| 29 | 1.1417 |  | 78 | 3.0709 |  | 1371.6 | 54     |
| 30 | 1.1811 |  | 79 | 3.1102 |  | 1524.0 | 60     |
| 31 | 1.2205 |  | 80 | 3.1496 |  | 1828.8 | 72     |
| 32 | 1.2598 |  | 81 | 3.1890 |  | 2133.6 | 84     |
| 33 | 1.2992 |  | 82 | 3.2283 |  | 2438.4 | 96     |
| 34 | 1.3386 |  | 83 | 3.2677 |  | 2743.2 | 108    |
| 35 | 1.3780 |  | 84 | 3.3071 |  | 3048.0 | 120    |
| 36 | 1.4173 |  | 85 | 3.3465 |  |        |        |
| 37 | 1.4567 |  | 86 | 3.3858 |  |        |        |
| 38 | 1.4961 |  | 87 | 3.4252 |  |        |        |
| 39 | 1.5354 |  | 88 | 3.4646 |  |        |        |
| 40 | 1.5748 |  | 89 | 3.5039 |  |        |        |

## RECOMMENDED TIME LIMIT FOR TOOLING IN OVEN

| Temperature | After Reaching Temperature |
|-------------|----------------------------|
| 500°F       | Unlimited                  |
| 600°F       | 30 hours                   |
| 700°F       | 10 hours                   |

| Temperature | After Reaching Temperature |
|-------------|----------------------------|
| 800°F       | 6 hours                    |
| 900°F       | 2 hours                    |

## THERMOCOUPLE TYPES USED IN EXTRUSION PLANTS

### Type J

| Iron-Constantan (I/C) | one wire silver and one wire bronze in color |                  |
|-----------------------|----------------------------------------------|------------------|
| Iron:                 | Magnetic                                     | Positive — White |
| Constantan:           | Non-magnetic                                 | Negative — Red   |

### Type K

| Chromel/Alumel (C/A) | both wires silver in color |                   |
|----------------------|----------------------------|-------------------|
| Chromel:             | Non-magnetic               | Positive — Yellow |
| Alumel:              | Magnetic                   | Negative — Red    |

Note: Thermocouple lead wire must be located in a dry, grounded, steel conduit and separated from power wiring. Do not use wire-pulling lubricant.

## GLOSSARY OF TERMS FOR PRESS COMPONENTS

**Press Base or Bedplate:** a welded structure, it is designed to accurately position and support the press structure. It is precisely leveled, anchored, and grouted to the concrete press foundation.

**Main Cylinder:** the hydraulic cylinder, normally cast or forged steel, incorporates the Main Cylinder Flange, also sometimes called the Main Cylinder Platen; other Main Cylinder parts include the Main Cylinder Bearing Bushing and Main Cylinder Packing system.

**Main Ram:** the piston of the main hydraulic cylinder.

**Crosshead (or Moving Crosshead):** mounted on the Main Ram, the Crosshead is fitted with the Extrusion Stem, and with guide shoes to guide the main ram travel along the .

**Crosshead Cylinders or Pullback Cylinders:** for rapid pull-back of the main ram at speeds not possible using main cylinder action alone; mounted on the Main Cylinder housing or Platen.

**Extrusion Stem** or **Ram Stem**: pushes the billet through the Container. Various mounting designs are used to permit precise adjustment and alignment of the stem. To avoid sticking or “welding” to the billet, a Dummy Block is fixed to the nose of the stem. Older presses used Loose Dummy Blocks, mechanically fed into position with each bullet, then removed, separated, and recycled. Today almost all presses incorporate Fixed Dummy Blocks mounted on the Stem.

**Guide Ways**: for guiding the Moveable Crosshead and Container, although many presses use separate guide systems for each. Guide ways are usually mounted on the Press Frame or Bedplate, or on the Columns or Tie-Rods.

**Tie Rods** or **Columns**: operating in tension, these restrain the extrusion force between the Main Cylinder Platen and Front or Resistance Platen. The most common designs are: threaded tension rods with 4 nuts per rod (2 at each platen); threaded rods with fixed sleeves between platens; and laminated plates or bars.

**Platen** (also **Front Platen** or **Resistance Platen**): cast or forged steel, it provides support for extrusion tooling and so is designed for minimum deflection under load. It incorporates also the Pressure Ring, a replaceable precision segment designed for extremely precise support of the Tooling Stack.

**Tooling Stack** or **Die Stack**: includes the die, die backer, bolster, die ring, and other spacers as may be required to adapt a particular die to the standardized overall Tooling Stack dimensions for the particular press.

**Die Changer**: a device for rapid changing of dies. Common designs include:

- single die changer: the simplest system, it holds only one tooling stack at a time.
- double die slide: holds two tooling stacks, allowing advance set-up of the next set during extrusion and therefore faster die changes; but one pocket must be loaded from the far side of the press, away from the press operator’s position.
- unistation die changer: also allows advance set-up and quick changes, fully accessible from the operator side of the press; dies are exchanged in a “shuttle” motion.
- rotostation die changer: similar to unistation, except a turntable rotates for exchanging die carriers.
- gate lock: on very old presses, dies are removed and reinserted through the front platen, then locked in place with a “gate lock” device, which also absorbs the resistance forces.

**Container**: retains the extrusion pressure against the die by containing the billet; incorporates a replaceable Container Liner to accommodate wearing tendencies.

**Container Holder**: supports, guides, and transports the Container; connected to the Container Cylinders and mounted on Guide Shoes which slide on the . Also incorporates Container Heating Elements, and their flexible electrical connections; and locking devices to retain the container firmly and precisely in position.

**Container Cylinders**: move the container away from the Tooling Stack during butt shearing (also during “burp cycle” and die changing); and provide sealing pressure to retain the container firmly against the Tooling Stack during extrusion.

**Billet Loader:** most commonly a swing-arm device mounted to the press frame. However, on newer presses this loader may be a robot device or an overhead carrier for increased reliability and positioning accuracy.

**Butt Shear:** for removal of the remaining billet or “butt” at the end of the extrusion cycle, a hydraulically powered blade descends to shear away the remainder. To insure complete removal, a “Butt Kocker,” usually pneumatically actuated, may also be provided to sweep the blade area.

## DIAGRAMS OF PRESS COMPONENTS

In order to provide a common reference of terminology, please see the extrusion press diagrams shown on the following pages. Terms used throughout this manual are defined according to this diagram and the Glossary of Terms for Press Components above.



